

## Beam Loss Monitor

# A Study on the Improvement of Gamma-ray Response and Electric Output of Beam Loss Monitor

17

PEFP(Proton Engineering Frontier Project)

Beam Loss Monitor (BLM) Ionization Chamber가

Collection Efficiency가 가

Electrode Wall ,

Chamber Response

가

. BLM Ionization Chamber

BLM Ionization Chamber

Ionization Chamber Outer

. Ionization

EGSnrc(DOSRZnrc)

## ABSTRACT

A beam loss monitor (BLM) has been designed for the PEFP (Proton Engineering Frontier Project). An accelerator facility with a high intensity beam needs the beam loss monitoring system for the primary diagnostic tool for tuning and preventing excess activation and equipment damage. Generally, ionization chamber has been used as a BLM, but it has a disadvantage that its electric output is lower than other detectors. To improve the electric output of BLM, outer electrode wall material, its thickness, and the inner gas between outer electrode and inner electrode were changed. And the variation of electric output according to the change was investigated. The EGSnrc (DOSRZnrc) that use the Monte Carlo method was introduced to simulate the electric output of the BLM.

1.

PEFP(Proton Engineering Frontier Project) 100MeV, 20mA  
 가 (Proton Linear Accelerator with High Intensity) 가  
 Excess Activation BLM(Beam Loss  
 Monitor) . BLM 가 ,

Ionization Chamber  
 가 Ionization chamber BLM  
 Ionization Chamber BLM (Ion Collection Time)  
 가  
 Collection Efficiency가 가 . [2]  
 Ionization Chamber Collection Efficiency Thomson (1) (2)  
 Ionization Chamber d (Equivalent Gap)  
 vol (Collecting Volume) V .[2]

$$f = \frac{1}{1 + \xi^2} \quad (1)$$

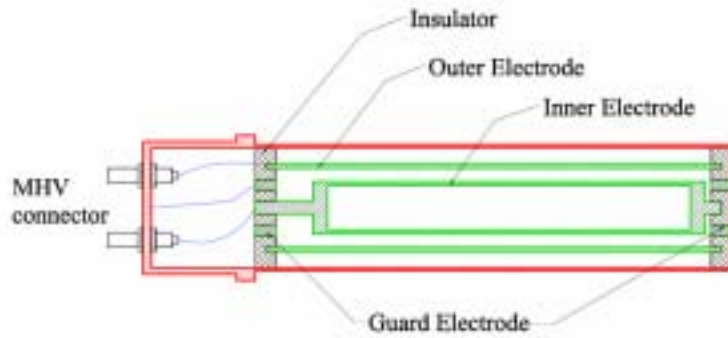
$$\xi^2 = \left( \frac{\alpha}{6ek_1k_2} \right) \left( \frac{d^4}{V^2} \right) \left( \frac{Q_\infty}{vol} \right) \quad (2)$$

Ionization Chamber BLM  
 Ionization Chamber BLM Outer Electrode , Collecting Volume Gas  
 BLM BLM

## 2.

### 2.1 Prototype Ionization Chamber

Ionization Chamber BLM 1  
 Prototype BLM 210mm 2mm  
 Outer Electrode 42mm Inner Electrode 25mm . Collecting  
 Electrode 가 Guard Electrode Inner  
 Electrode Outer Electrode . Electrode Teflon  
 2mm Housing .



### 1. Ionization Chamber Beam Loss Monitor

#### 2.2

Prototype Ionization Chamber BLM /  
 EGSnrc , NRC User codes R-Z Geometry Dose Pulse Height  
 Distribution DOSRZnrc .  
 BLM Outer Electrode Wall , , PVDF, PMMA  
 BLM . Outer Electrode Wall  
 PVDF 1MeV 가 2mm 4mm 0.4mm  
 BLM .  
 Outer Electrode Inner Electrode Collecting Volume  
 Leakage Leakage Control System 가 Air-Filled BLM  
 . Ne, Ar Xe BLM  
 . 1 Outer Electrode Wall Gas

1. BLM Gas Wall Material Density

Gas	Density (g/cm <sup>3</sup> )	Wall Material	Density (g/cm <sup>3</sup> )
Ne	0.0008	PMMA	1.1900
Air	0.0013	PVDF	1.7600
Ar	0.0017	Aluminum	2.7020
Xe	0.0025	Copper	8.9333

### 3.

#### 3.1 Wall Material

Outer Electrode Wall 1 PMMA, PVDF, BLM Outer

BLM Gas Volume . BLM Outer

Electrode 60keV 10MeV 가 2

3 4가 Wall Material BLM 3 가 가

PMMA

60keV Housing Outer

Electrode Wall 가 BLM

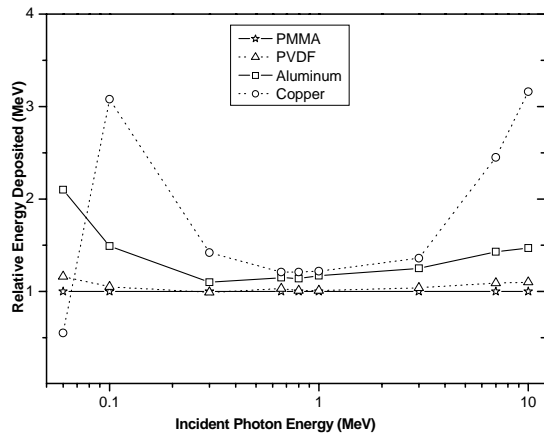
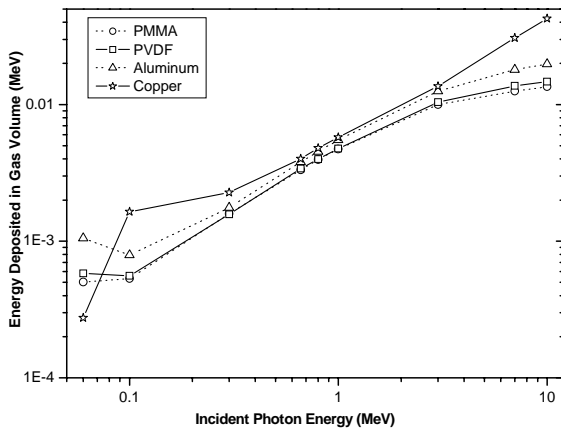
PVDF 60keV

60keV 가

4 60keV 3MeV 4가

가 3MeV 10MeV 가

3



**2. Wall Material BLM**

PVDF Outer Electrode Wall 1MeV Outer Electrode

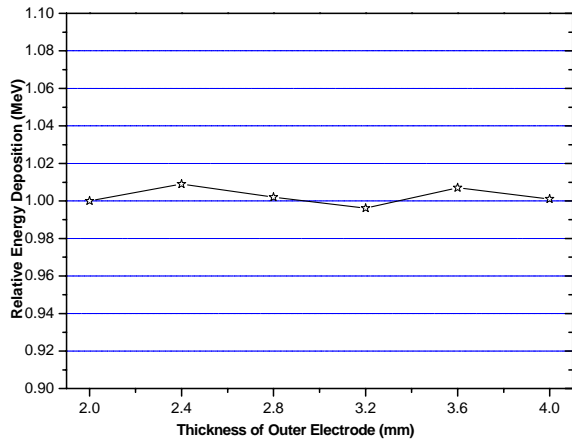
Wall . 4 Outer Electrode Wall

PVDF , 2%

2mm PVDF Wall 1MeV

가 가

**3. Wall Material BLM**



**4. Wall BLM**

**3.2 Gas**

Ionization Chamber BLM                      Collecting Volume Gas

5      가 가      Ne                      Gas                      1

. Xe      Ne      3                      가      2

가      Ne      1.5      2                      가      Ar      1.7

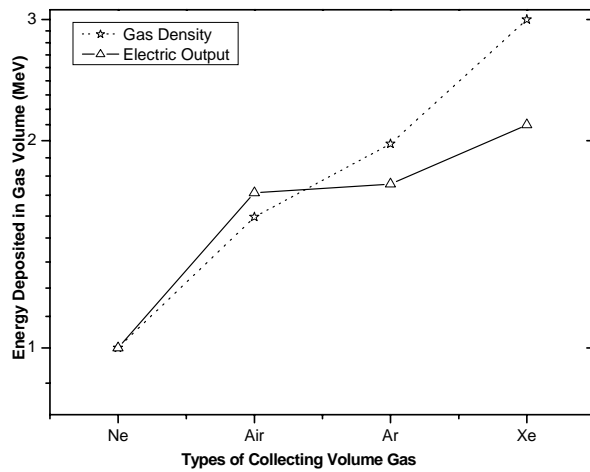
가

Gas      가 가      BLM Gas                      가

가                      가 가                      가

,                      BLM

가                      .[3]



**5. Collecting Gas BLM**

4.

, PEFP(Proton Engineering Frontier Project)                      Beam Loss Monitor(BLM)

Ionization Chamber    Outer Electrode Wall                      ,

Collecting Gas                      가                      가                      .                      , Outer

Electrode Wall                      3MeV                      10MeV                      가 가                      3MeV

. Outer

Electrode Wall (PVDF)                      1MeV                      2%

Wall

가                      .

가

가                      가                      가                      가                      .

Leakage                      가                      가                      Noble Gas

1. R. L. Witkover, and D. Gassner, "Design and Testing of the New Ion Chamber Loss Monitor for SNS, " SNS-Report, 2002.
2. Se Hwan PARK, Yong Kyun Kim, et. al, "Design of Ion Chamber for Beam Loss Monitor of PEFP," ISORD-2, 2003.
3. Michael Plum, and David Brown, "Response of Air-Filled Ion Chambers to High-Intensity Radiation Pulses," Particle Accelerator Conference, Proceedings of the 1993 , 17-20 May 1993.